A Bibliometric Analysis of Publications on Spinal Cord Injury in Türkiye: Current State of Researches: A Descriptive Study

Türkiye'de Yapılan Omurilik Hasarı ile İlgili Çalışmaların Bibliyometrik Analizi: Çalışmaların Güncel Durumu: Tanımlayıcı Bir Çalışma

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ABSTRACT Objective: The aim of this study was to investigate the present situation of spinal cord injury studies in our country, and provide awareness for following investigations. **Material and Methods:** We searched the articles about spinal cord injury using Web of Science database. Evaluations based upon publication data. Bibliometric assessments were carried out using VOSviewer. **Results:** 1,609 articles were described associated with spinal cord injury in Türkiye. Spinal cord injury, spinal cord, paraplegia, rat and metilprednisolone were the top 5 ranked keywords unlike the world literature and up-to date trends. The number of publications per year increased from 2007 to 2013. The maximum number of publications was in 2013 and then started to decrease in 2014. Although there was an increase in the number of publications in 2015 compared to 2014, the decrease in the number of publications continued to increase over the years. **Conclusion:** This research extensively examined the facts of spinal cord injury studies in our country. Results can be interpreted that the interest of researchers in our country on spinal cord injury has decreased. The results of this study can also supply information to the researchers releated to spinal cord injury worlwide and an awareness base for following projects in the future.

Keywords: Spinal cord injury; bibliometric assessment; rehabilitation

ÖZET Amaç: Bu çalışmanın amacı, ülkemizde omurilik yaralanması ile ilgili çalışmaların mevcut durumunu araştırmak ve bundan sonraki araştırmalar için farkındalık sağlamaktır. **Gereç ve Yöntemler:** Web of Science veri tabanını kullanarak ülkemizde yapılan omurilik yaralanması ile ilgili makaleleri taradık. Bibliyometrik değerlendirmeler ise VOSviewer kullanılarak yapıldı. **Bulgular:** Türkiye'de omurilik yaralanmasıyla ilgili 1.609 makale tanımlandı. Omurilik yaralanması, omurilik, parapleji, rat ve metilprednizolon, dünya literatüründen ve güncel trendlerden farklı olarak ilk 5'te yer alan anahtar kelimeler oldu. 2007 yılından 2013 yılına kadar yıllık yayın sayısının artış göstermiş olduğunu tespit ettik. En fazla yayın sayısı 2013 yılında olmuş olup daha sonra 2014 yılında azalmaya başlamıştır. 2015 yılında 2014 yılına göre yayın sayısında artış olmasına rağmen bu yıldan sonra ülkemizden yapılan yayın sayısı yıllar geçtikçe azalmaya devam etmiştir. **Sonuç:** Bu araştırma, ülkemizdeki omurilik yaralanması araştırmaları ile ilgili kapsamlı bir inceleme imkânı sunmaktadır. Sonuçlar ülkemizdeki araştırmacıların spinal kord yaralanmasına olan ilgisinin azaldığı şeklinde yorumlanabilir. Bu çalışmanın sonuçları aynı zamanda dünya çapında spinal kord yaralanması ile ilgili araştırmacılara bilgi sağlayabilir ve gelecekte yapılacak projeler için bir farkındalık oluşturabilir.

Anahtar Kelimeler: Spinal kord hasarı; bibliyometrik değerlendirme; rehabilitasyon

Spinal cord injury (SCI) causes many dysfunctions including motor, sensory, autonomic components and has many complications leading to debilitating conditions on physical, psychological and social functions. SCI and its complications also cause economic burden to patients and society. The technological and medical advances in rehabilitation have improved the life quality of individuals with SCI. SCI is one of the most investigated topic in global literature because of its increasing prevalance and the lack

of an efficacious treatment.[1] It is important to shape the future studies by providing a knowledge base about recent trends, hot topics and spatial structure of the SCI researches in our country.

Bibliometrics is a methodology to assess the researches in an area in terms of publication quality, topics and status. Bibliometric studies supplies a short summarisation of the literature. VOSviewer is a visual and bibliometric investigation software computer program for bibliometric mapping developed by van Eck and Waltman.[2] It produces searching maps based on network data about co-authorships, co-occurence, citation, bibliographic coupling, co-citations, research hotspots and trends. The number of bibliometric analysis is increasing in all science disciplines worlwide. In the literature there are studies assessing the global outputs about SCI.[3,4] Our study aims to evaluate the present scientific stature of SCI studies in our country and describe a knowledge base for future researches. The importance of our study is the lack of a study in the literature consisting of our country reality about SCI publications.

MATERIAL AND METHODS

We downloaded all the articles from our country using Web of Science (WoS) with the keywords "spinal cord injury" or "spinal cord injur" or "paraplegia" or "tetraplegia" in the all fields search without time period limitations (Access date: 10.10.2023). We excluded countries except for Türkiye and Türkiye. We searched the articles based upon publication data (publication years, researcher profiles, authors, web of sciences categories, citation topics, web of science index, affiliations, publication titles, research areas were obtained). We prefered WoS for searching publications because it is a more trustworthy database compared with others. Bibliometric web visualizations (analysis of keywords, network visualisation mapping for current trend key words, collaboration and co-occurrence analysis) were carried on using VOSviewer (version 1.6.10) program package.

The visual information formed by VOSviewer contains lines and nodes. Nodes symbolize items like institutions, authors, cited references and lines between nodes symbolize co-citation, co-occurring re-

lations. The dimension of each node shows how often the item published or referenced and it is correlated with the frequence of occurrence. The connecting lines show co-occurrence between two nodes, and the thickness of the lines shows the power of the co-occurrence. Node and line colors show different years.

Cluster Analysis is made by VOSviewer to describe representations and relations between complex datasets. It classifies data items into groups called clusters. Classifying data sets according to their similarities and differences helps researchers to have perceptions about the fundamental structure of data. The cluster map of timeline allows indication of investigation trends. The study protocol was appropriate in accordance with the Declaration of Helsinki.

Bibliographic coupling analysis of the authors were also done by using VOSviewer. Bibliographic coupling analysis helps to find the amount of common references cited in two articles so it identifies the similarity relation between publications. Bibliographic coupling happens when two studies reference a same third study in their references and helps researchers to find out previous related researches.[2]

RESULTS

A total of 1,609 articles about SCI were indexed in WoS from Türkiye or Türkiye. The number of articles per year increased steadily from 2007 to 2013. The maximum number of publications was in 2013 and then started to decrease in 2014. Although there was an increase in the number of publications in 2015 compared to 2014, the decrease in the number of publications continued to increase over the years. Figure 1 shows the number of publications per year.

Figure 2 shows the top 10 ranked countries producing the most articles where Türkiye was in 15th place after Sweden.

A visual expedition of authors that published articles on SCI by publication counts are showed in Figure 3. Hacettepe University, İstanbul University and Gülhane Military Medical Academy were the top 3 ranked institutions by publication count. Spinal Cord (n=89), Journal of Spinal Cord Medicine (n=80), and Turkish Neurosurgery (n=58) were the
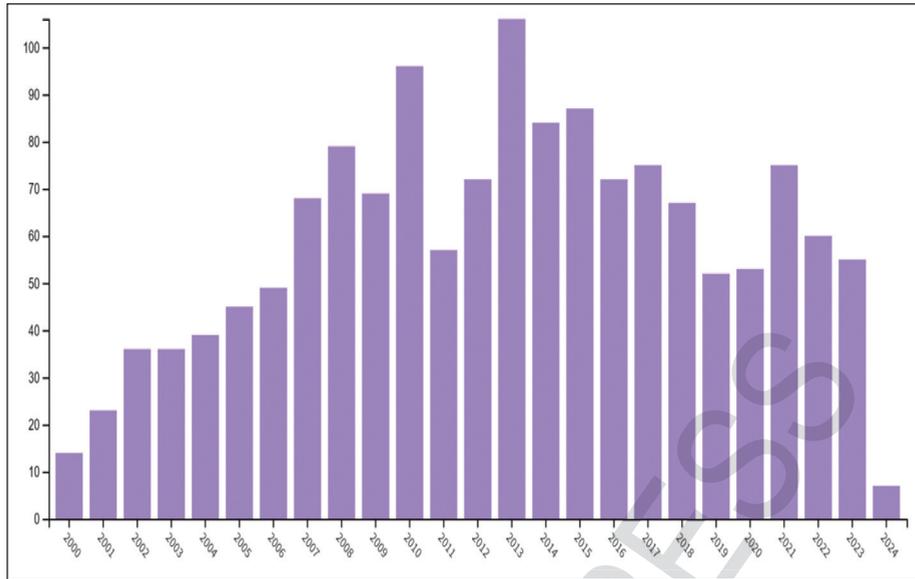
FIGURE 1: The number of publications per year.

FIGURE 2: The top 10 ranked countries producing the most articles.

top 3 ranked journals by publication count. Clinical Neurology (582), Surgery (361), Rehabilitation (260) were the top 3 web of science categories. Neurosciences Neurology (703), Surgery (361), Rehabilitation (260) were the top 3 research areas. A total of 1,387 publications were indexed in Science Citation Index-expanded, 159 publications indexed in Emergency Sources Citation Index and 74 in Social Sciences Citation Index.

Figure 4 shows a key word cluster analysis in a form of network visualization map. Each color intimates the clustering among the key words. The di-mension of the circles shows the frequence of this keyword. The thickness of the lines shows the key words usually used together in similar researches. There were 3,033 key words used in 1,609 articles. These words included 10 key words that were used at least in 50 articles. SCI, spinal cord, paraplegia, rat, metilprednisolone were the top 5 ranked keywords. Neuroprotection, rehabilitation, lipid peroxidation, oxidatice stress and spinal cord injuries were the other keywords.

Figure 5 shows network visualisation mapping for current trend key words based on our analysis.

FIGURE 3: The authors that published articles on spinal cord injury by publication counts.
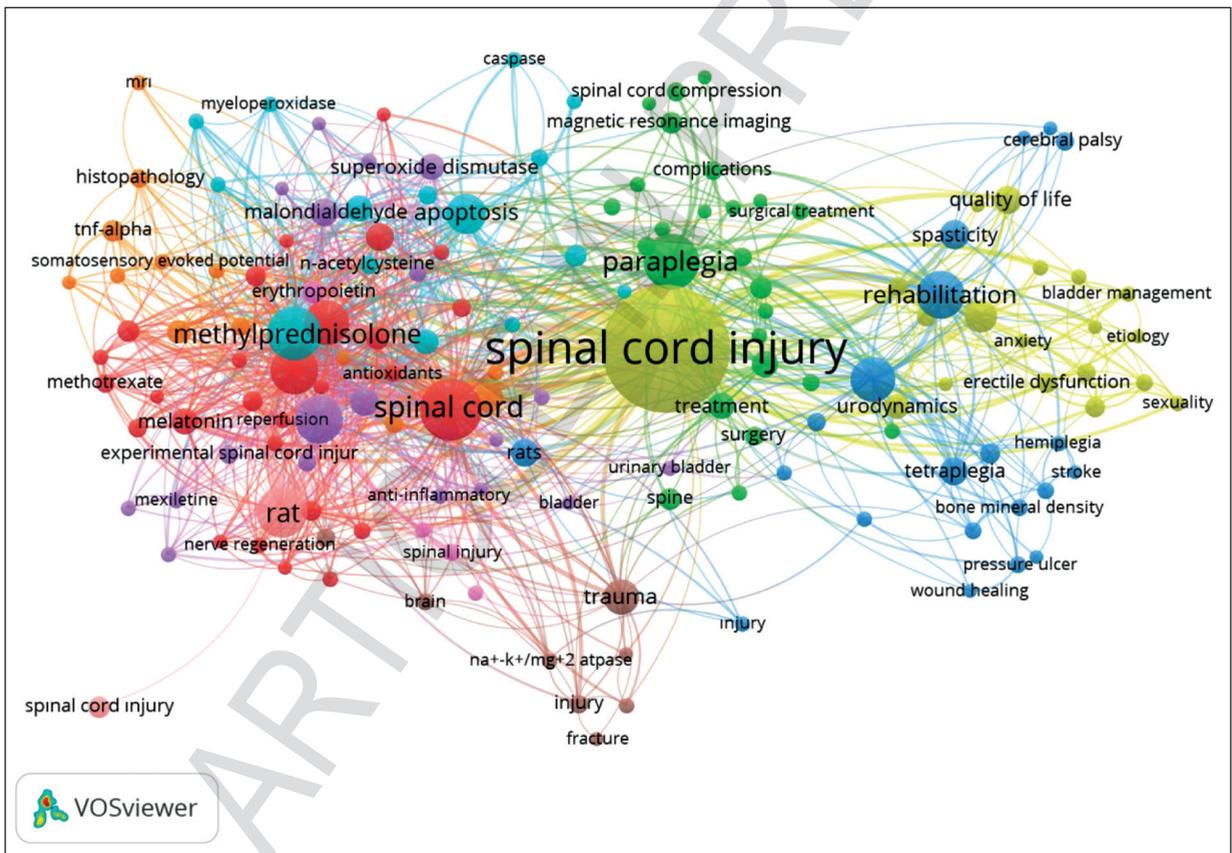
FIGURE 4: A key word cluster analysis in a form of network visualization map.

Current publications were seen from purple to yellow in the indicator. Rats, sexuality, quality of life were the keywords with an increased number in recent years. Bibliographic coupling analysis of the authors is shown in Figure 6.

DISCUSSION

In our study the most productive journals were Spinal Cord, Journal of Spinal Cord Medicine and Turkish Neurosurgery. In Kiraz and Demir bibliometric study
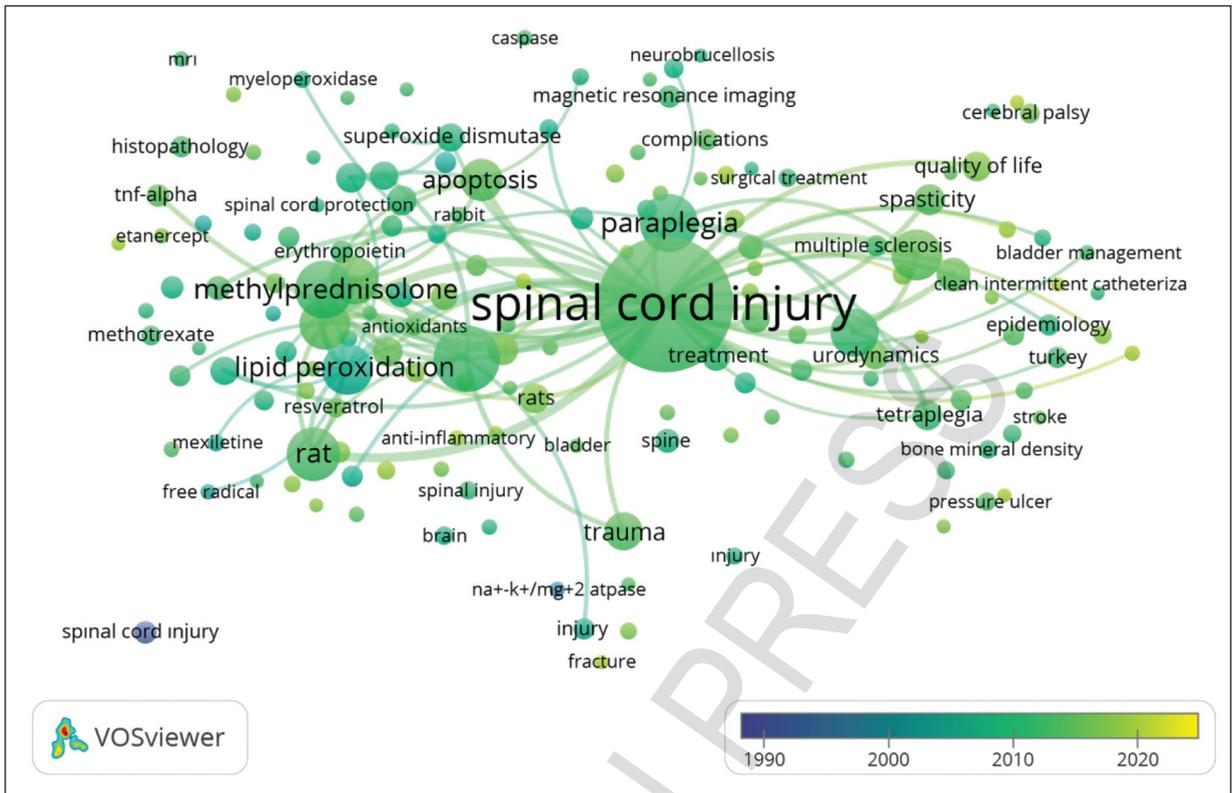
FIGURE 5: A network visualisation mapping for current trend key words.
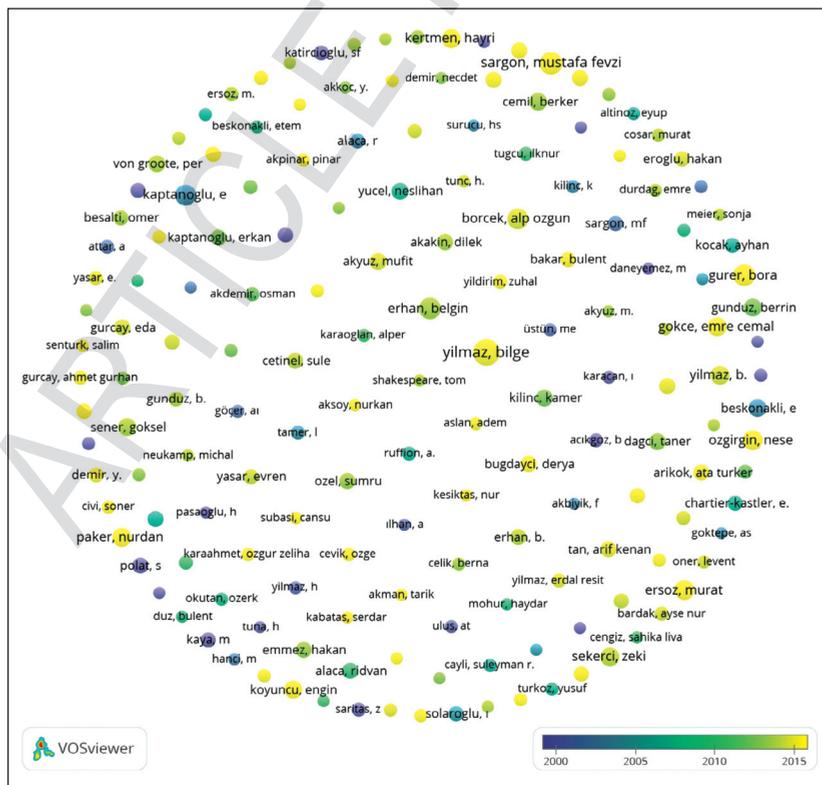
FIGURE 6: Bibliographic coupling analysis of the authors.

about worlwide global scientific outputs on SCI between 1980 and 2018 the most productive journals were Spinal Cord, Archives of Physical Medicine and Rehabilitation and Journal of Neurotrauma, the most proliferous countries were United States of America, China, and Canada.[5] There was a statistically significant correlation between the number of publications about SCI and the gross domestic product of the countries'. They found that the current trend key words were neuroplasticity, cell transplantation, neural regeneration, axon regeneration, neural stem cells, autophagy, oxidative stress, inflammation, glial scar. Up-to date trends were usually about cellular level of molecular therapies. Regeneration, transplantation, inflammation, astrocytes, plasticity, microglia, macrophage and locomotion were the keywords used in the top cited articles. Unlike the world literature and up-to date trends in our study SCI, spinal cord, paraplegia, rat and metilprednisolone were the 5 ranked keywords.

Li et al. analyzed the global trends in SCI during the last 20 years. They declared, there was an increment in the number of publications between 1999 and 2019. This result suggests that researches in SCI were in an advancing status of growth and development. Unfortunately in our country number of publications in SCI decreased after 2014. It can be interpreted as a decrease of interest in researchers about SCI. United States of America was the leader country in terms of H index, citation and publication count. H-index of United States of America was 196. In our study, H-index of Türkiye was 58. United States of America was also at the centre of SCI research. This might be related to the economic development level of the countries and so the huge total of funds inducted in SCI studies. Co-occurrence analysis showed a broad collaboration between countries. United States of America had the most collaborationisms and China was the 2. Although China's academic effect was presently low, researchers in China were enthusiastic to work together and the investigation circumstances in China was developing.[4]

12 clusters were proceeded with the analysis of co-occurring keywords; neuroprotection, apoptosis, paraplegia, differentiation, family, quality of life, response, methylprednisolone, cervical spine, tetraple-gia and microglia. Between 1999 and 2002, there were 12 clusters. Between 2003 and 2008, amount of influential researches and the number of clusters decreased. Stem cells, neuropathic pain, differentiation, neuron outgrowth, activation and mortality were the research hotspots. Research topics were more heterogeneous between 2009 and 2019, with research hotspots focused on epidemiology and cervical spine, disease, microglia, apoptosis, quality of life were the main clusters. Usually, researches converged on natural history, pathology and interventions of SCI. Epidemiology has become a popular research area later, supporting evidence about global prevalence and incidence of SCI. In our country the epidemiologic studies are limited.[6-8] Considering the trends according to changing keywords over the years in our country; between 2008-2010 lipid peroxidation, methylprednisolene, superoxide dismutase and neuroprotection were the research hotspots. Between 2010-2015 neuroprotection, oxidative stress and rats, between 2015-2020, methylprednisole, neuroprotection, lipid peroxidation and between 2020-2022 rat, apopitosis, neuroprotection were the research hotspots. Our results showed that there is not much changes in trends over the years in our country. This can also be caused because of the careless selection of keywords.

In the literature there are bibliometric studies on pain after SCI and treatments of SCI with the trends inflammation, individual, and central sensitization.[9] Glucocorticoid usage in SCI was also identified bibliometrically.[10] The publication rate and amount showed a trend for stem cell theraphies in SCI. Stem cell transplantation, tissue engineering, recovery of motor function, neural regeneration and exosomes were the current research areas in this field. Future research points were especially about molecular mechanisms, hydrogels, exosomes, scaffolds and inflammatory responses of stem cell therapy for SCI.[11] In our study keywords with an increased number in recent years were rats, sexuality and quality of life showing the focus of current direction in SCI field is quite different in our country from the world perspective.

Unlike the study subjects conducted in our country there is an increase in number of publications about electroactive materials and SCI. University of Toronto is the most productive institution in this

search area. The most of authors are from the United States of America and China. Published articles about electroactive materials and SCI were mainly about functional rehabilitation, carbon-based materials and surgery. The function and mechanism of injectable hydrogels in spinal cord healing was a hotspot, mainly focalising on the inhibition of oxidative stress and apoptosis.[12]

Researches on SCI-induced neurogenic bladder includes rehabilitation, urology, nephrology and clinical neurology and it is still a hot topic also in our country that will continue to produce a significant research interest for future.[13] Another bibliometric study revealed that SCI rehabilitation studies before 2005 concerned the beginning phase when solutions were found to ordinary problems, between 2005-2011 there was an expeditious progress when solutions were found to main problems, and after 2011 there was a slow progress. The decrease in yearly study development since 2011 shows a growth problem and maybe a tiredness in this area. Muscle strength, walking, wheelchair training, life satisfaction, gait were the hot spots of these research studies, whereas adult, exoskeleton, plasticity, classification were research frontiers according to keyword analysis unlike the hot spots and research frontiers in the studies conducted in our country. There is a need of higher quality researches about new issues and technologies such as stem cell therapy, brain–computer interface, artificial intelligence and global scientific research cooperation for all researchers.[14] The main limitation of our study is that it did not involve the other databases. As WoS indexes journals with high impact factor we think it is more reliable, also including other databases causes recurring analysis of the same article.

CONCLUSION

This summary can highlight the researchers about the current information on SCI publications (topics, distribution by years, trend topics studied) in our country. Results can be interpreted that the interest of researchers in our country on SCI has decreased over the years. Supplying more sources for clinical and basic studies associated with SCI is essential for the enhancement of SCI rehabilitation in our country. The results of this study can also supply information to the researchers releated to SCI and an awareness base for following projects in the future.

Source of Finance

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: Bilge Yılmaz, Özlem Köroğlu; Design: Bilge Yılmaz, Özlem Köroğlu; Control/Supervision: Bilge Yılmaz, Özlem Köroğlu, Fatma Özcan, Nazmiye Merve Örücü Atar; Analysis and/or Interpretation: Bilge Yılmaz, Özlem Köroğlu, Fatma Özcan, Nazmiye Merve Örücü Atar; Literature Review: Bilge Yılmaz, Özlem Köroğlu, Fatma Özcan, Nazmiye Merve Örücü Atar; Writing the Article: Özlem Köroğlu; Critical Review: Bilge Yılmaz, Fatma Özcan, Nazmiye Merve Örücü Atar.

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